


## 7.5b Applications of Integrals

## Fluid pressure

Why are dams thicker at the bottom?

Does the fluid pressure at any point on a dam depend on the amount of water held back by the dam?



$$p = w \cdot h$$

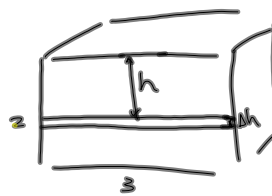
weight density

$$p = \frac{F}{A}$$

$$F = p \cdot A = w \cdot h \cdot A$$

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What is the total force on the front side of an aquarium if the side is 3ft wide by 2ft tall?



$$\Delta F = \text{force on strip}$$

$$\Delta F = p \Delta A$$

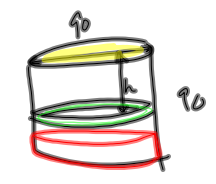
$$\Delta F = w h \cdot 3 \Delta h$$

$$\Delta F = 62.4 \cdot h \cdot 3 \Delta h$$

$$F = \int_0^2 62.4 h \cdot 3 \, dh = 374 \text{ lbs}$$

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The Puritan Distilling Company had a 90 ft high, 90 ft diameter cylindrical metal tank filled with molasses which weighs 100 lb/ft<sup>3</sup>. In 1919 the tank exploded due to fluid pressure. What was the total fluid force on the tank wall?



$$\Delta F = w h \Delta A$$

$$= 100 \cdot h \cdot 90\pi \cdot \Delta h$$

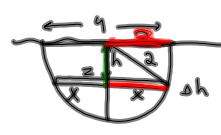
$$F = \int_0^{90} 100 h 90\pi \, dh = 114,511,052 \text{ lb}$$

bottom 1 ft strip

$$\int_{89}^{90} 100 h 90\pi \, dh = 2,530,554$$

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A steel plate in the shape of a semicircle is submerged vertically in sea water. Find the fluid force on the plate if it has a 4 ft diameter.



$$\Delta F = w \cdot h \Delta A$$

$$= 64 h 2x \Delta h$$

$$F = \int_0^2 64 h 2x \, dh$$

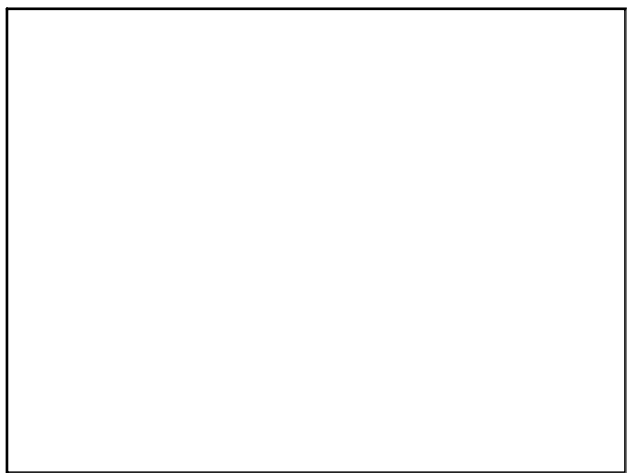
$$F = \int_0^2 64 h 2\sqrt{4-h^2} \, dh$$

$$= 341 \text{ lbs}$$

$$h^2 + x^2 = 2^2$$

$$x = \sqrt{4-h^2}$$

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